DEVICE FOR TRANSPORTING SHEET-SHAPED MATERIALS

Field of the Invention

The invention relates to a device for alternate transporting of sheet-shaped materials.

Background Art

Transport devices for sheet-shaped materials are typically found in printing machines, especially digital printers and copiers. A typical transport device utilizes transport rollers or transport belts that come into frictional contact with the sheet-shaped material to be transported and then slide it in the transport direction. To do this, generally transport element pairs are used in order to prevent a change in the alignment of the sheet-shaped materials during transport. For this very reason, it is generally desirable to hold the sheet-shaped material in at least two points on its transport path through the printer at all times. In order also to reliably ensure contact with the transport elements, in many printers, frictional wheels are used as pressure elements that are in working connection with the transport rollers to produce an adequately high contact pressure between sheet-shaped material and transport element.

Sheet-shaped material is typically repeatedly, wherein the sheet-shaped material is guided against a stop or comes in contact with specially driven frictional wheels that carry out the alignment. At this time, the transport elements must not be in contact with the sheet-shaped material in order for alignment to be carried out. In some printers, the sheet-shaped materials are delivered by the transport elements to the alignment elements and then accepted from them again. In some of these printers, there can be special space savings in the delivery, in that the transport elements are moved out of the way as soon as the sheet-shaped material has been delivered to the alignment elements. Generally, this is done by raising the frictional wheels to thereby interrupt the working connection between the transport elements and the frictional wheels.

German patent DE 42 43 986 C2 describes a device that changes direction of sheet-shaped materials having transport elements that are mounted on a rigid plate are brought into contact with the sheet-shaped materials due to the effect of an eccentric element.

Brief Description of the Drawings

Fig. 1 is a schematic isometric view of a first embodiment of the device according to the invention with the spring plate in the active bending state;

Fig. 2 is a schematic side view of a first embodiment of the device according to the invention with the spring plate in the active bending state;

Fig. 3 is a schematic isometric view of a first embodiment of the device according to the invention with the spring plate in the passive bending state;

Fig. 4 is a schematic side view of a first embodiment of the device according to the invention with the spring plate in the passive bending state;

Fig. 5 is a schematic isometric view of a second embodiment of the device according to the invention with the spring plate in the active bending state;

Fig. 6 is a schematic side view of a second embodiment of the device according to the invention with the spring plate in the active bending state;

Fig. 7 is a schematic isometric view of a second embodiment of the device according to the invention with the spring plate in the passive bending state.

Fig. 8 is a schematic side view of a second embodiment of the device according to the invention with the spring plate in the passive bending state.

Detailed Description

Figures 1 to 8 show the overall structure of a device 100 according to the invention. Other drive and/or guide means, cam wheels and control elements that are generally known and adapted for operating the device are shown only schematically and/or will only be described in a general way. Device 100 may be part of a printing machine, of a copier or of a further processing device for sheet-shaped materials 1.

The transport rollers 50, 52, which are present in pairs, are mounted so that they can rotate on transport roller shafts 51, 53 that have parallel axes and are driven by drive means that

are not shown but are known to the person skilled in the art. These transport rollers 50, 52 are used for transport of the sheet-shaped materials 1 in the above-named device. In order to also be able to actually transport the sheet-shaped materials 1, the transport rollers 50, 52 are in working connection with frictional wheels 40, 42, which press on the transport rollers 50, 52 with a specific force and create the friction required that allows the transport rollers 50, 52 to transport the sheet-shaped materials 1 without lateral slipping and without scuffing marks developing on the sheet-shaped materials 1.

As Fig. 1 shows, the frictional wheels 40, 42 are fastened so that they can rotate on the ends of a spring plate 10. Frictional wheels 40, 42 are fastened on frictional wheel shafts 41, 43 that have parallel axes and have a slot in their center through which a spring plate tab 11 extends that forms the end of the spring plate 10. The frictional wheel shafts 41, 43 are mounted in such a way that a vertical movement of the frictional wheel shafts 41, 43 is permitted and thus a vertical movement of the frictional wheels 40, 42. The spring plate 10 is a plate manufactured of spring steel that is pre-deformed with a radius R3 in the first embodiment of the device according to the invention shown in Figures 1 to 4. The spring plate 10 is mounted on both sides with a first housing wall 21 and a second housing wall 22 parallel to the first. The spring plate 10 is mounted in such a way that the spring plate 10 can be bent from the active bending state shown in Figs. 1 and 2, in which the frictional wheels 40, 42 are in contact with the transport rollers 50, 52, to a passive bending state, in which the frictional wheels 40, 42 are not in contact with the transport rollers 50, 52, as shown in Figures 3 and 4. The contact forces of the frictional wheels 40, 42 are applied to the transport rollers 50, 52 due to the mounting of the spring plate 10 in the housing walls 21, 22.

Above the center of the spring plate 10, an actuating element 30, namely a cam wheel 30, is mounted that can be rotated by way of a cam wheel shaft 32 by a drive 34 that is also mounted on the housing 20. In this process, the drive is controlled by a controller 70. The cam wheel 30 has four cams 36, 38 offset from each other by 90°, whereby the first and third cams 36 have a first radius R1 and the second and fourth cams 38 have a second radius R2. The radius R1 is dimensioned here such that the first or third cam 36 is just in contact with the center of spring plate 10 when spring plate 10 is in the active bending state. The cam wheel changes its radius between the smaller radius R1 and the larger radius R2 continuously.

In order to lift the frictional wheels 40, 42 from the transport rollers, as shown in Figs. 3 and 4, the cam wheel 30 turns by 90° and in this way bends the spring plate 10 by means of the second cam 38 into an essentially flat bending state. At first the cam wheel 30 remains in this angular position and, by way of cam 38, counteracts the restoring force of the spring plate 10. The ends of the spring plate 10 that extend beyond the housing walls 21, 22 follow the bending state of the spring plate 10 and thereby lift the frictional wheels 40, 42 from the transport rollers 50, 52 so that a slot develops which is marked with the reference character 60. If the cam wheel is turned 90° further, the spring plate 10 will be brought continuously back to its original active bending state and the frictional wheels 40, 42 will come into contact again with the transport rollers 50, 52 as long as a sheet-shaped material 1 is not currently clamped between them.

The second embodiment of the device 100 according to the invention shown in Figures 5 to 8 has an almost identical structure to that of the first embodiment of the device 100, but in this case there is a flat spring plate 10 instead of the spring plate 10 bent with a radius R3 as in the first embodiment example.

In order to give the flat spring plate 10 the desired bend in the active bending state, leaf springs 24, 26 are mounted outside of the housing sides 21, 22, which compress the spring plate 10 in the spring plate plane and, because of this, create the desired bend. The spring plate 10, in the bending state shown in Figures 5 and 6, is in a stable equilibrium between the restoring force of the spring plate and the lateral leaf springs 24, 26. The lateral leaf springs 24, 26 are dimensioned so that in this state they just contact the housing walls 21, 22. In this state, the spring plate 10 is in a bi-stable state.

The spring plate 10 presses against the tabs of the leaf springs 24, 26. If the cam wheel 20 is now turned by 90°, the spring plate 10 is brought into a flat, passive bending state in which the frictional wheels 40, 42 are lifted back up off the transport rollers 50, 52. In order to compensate the shortening of the arc length of the spring plate 10 between the housing walls 21, 22 due to this change in bending state, the spring plate 10 pushes the leaf springs 24, 26 outward somewhat and stresses them, see Figure 8. The spring plate 10 is now in an unstable equilibrium between the two possible bi-stable equilibrium positions. In this state, no forces are acting in the direction normal to the surface of spring plate 10

however, a stop that is not shown prevents the spring plate 10 from dropping into the second, undesired bending state since the spring plate 10 would go out of the effective range of the cam wheel 30 if that were to occur. If the spring plate 10 is somewhat deflected in this state, the return forces of the lateral leaf springs 24, 26 cause the spring plate 10 to move back into its active bending state following the cam wheel. In the passive bending state of the second embodiment, the spring plate is not moved completely into the unstable state, so the restoring forces of the leaf springs 24, 26 press the spring plate against the cam wheel 30 with at least a slight force so that the return of the spring plate 10 to the active bending state is always ensured.

In an alternative embodiment, the actuator 30 is a lifting magnet with tappet that is not shown. Another alternative embodiment is only designed on one side, i.e. only has frictional wheels 40 on one side of the spring plate 10; the other end of spring plate 10 is mounted accordingly.

The device according to the invention disclosed here and the method according to the invention are especially used in a printing machine, a copier or another further processing device for sheet-shaped materials, but can also be used in other devices in which individual, essentially flat materials are transported with frictional contact by transport elements and the transport device will be switched on and off, in that the friction between the transport element and the material to be transported will be decreased.
Therefore, the object of the invention is to make available another device for alternate transport of sheet-shaped materials with which a reliable separation of transport elements and opposing rollers is possible.

The foregoing discussion describes a device for alternate transport of sheet-shaped materials, wherein the device has at least one frictional wheel as well as a housing, an actuating element, a drive for the actuating element, a control for the drive and at least one driven transport element, whereby at least one frictional wheel is mounted so that it can rotate at the end of a spring plate, whereby the spring plate is mounted with respect to the housing and the actuating element in such a way that the spring plate can be brought into a first active bending state and into a second passive bending state by means of the actuating element. In the active bending state the at least one frictional wheel is in working connection with the transport element, and in the passive bending state it is not.

The structure is simplified because of the use of a spring plate. Movement of the at least one frictional wheel, both the upward and the downward movement, is caused by an elastic deformation of a single component. Since it is a matter of an elastic deformation, no complicated slide bearings or other mechanisms are necessary that would be needed if components that are non-deformable carried out a movement, e.g. levers, rigid plates, etc. In addition, only very slight wear occurs in the elastic deformation of the spring plate, which is different from the movable, non-deformable parts in which the appearance of fatigue would occur much sooner.

In addition, in this context, the term bending state is understood as a state of bending of the spring plate within its elastic range; this explicitly includes the case in which the spring plate is flat and/or in an equilibrium bending state. A pre-bent spring plate, i.e. one that is provided with a radius, is under tension in a flat bending state, while in contrast a spring plate that is not bent is not under tension. Working connection in this case is understood to mean that the at least one frictional wheel applies an adequately high force in the direction of the transport element so that there is adequate friction between the transport element and a sheet-shaped material that will be transported between the transport element and the at least one frictional wheel to ensure the transport.

One bending state is an equilibrium bending state and in contrast the other bending state is a deflected bending state. Because of this, the required restoring forces occur automatically so that the spring plate can return from the second bending state to the first one. In this process, which of the bending states corresponds to the active position of the frictional wheel and which to the passive position is left to the discretion of the person skilled in the art.

Another advantage that results from the use of a spring plate is that most of the parameters can be determined using the forming and the mounting of the spring plate in the housing. This means, for example, the positioning of the spring plate in the housing can be used to influence the actuating travel of the frictional wheels or of the actuating element and the required forces that the actuating elements must apply. Among other things, the bending stiffness of the spring plate also determines the speed with which the spring plate bounces

from one bending state to the other on the basis of the restoring force, provided that the actuating element permits such a bounce.

In one embodiment at least one (preferably a pair of) frictional wheel is mounted so that it can rotate on each side of the spring plate. In this way, the upward and downward movement of the four frictional wheels can be carried out without the use of additional components, whereby at the same time it can be ensured that the movement of all four frictional wheels is carried out simultaneously.

In another advantageous embodiment of the device according to the invention, the spring plate is previously deformed with a radius. This means the spring plate is in an unstressed mono-stable bending state if it curves with the previously deformed radius. If the previously deformed spring plate is installed in the housing in such a way that at least one frictional wheel comes into active contact with the transport element, the at least one frictional wheel can be lifted by the actuating element, in that the actuating element brings the spring plate e.g. into an essentially flat bending state. Because of the restoring forces thereby generated and the mono-stable behavior of the spring plate, it is now only necessary to eliminate the force that the actuating element exerts on the spring plate in order to return the spring plate to its original position with defined contact force between the at least one frictional wheel and the transport element.

In another embodiment of the device according to the invention, the spring plate is in a bi-stable bending state in one of the bending states. For example, a bi-stable state is obtained if a flat spring plate has a length L between two bearings, but the distance between the bearings is somewhat less than this length L. Then the spring plate bulges either downward or upward into one of the two stable bending states. Because of a specific force (that depends on the type of bearing used), the spring plate can be pushed into its second stable state through its center position. The advantage of bi-stable bending states is that in the respective bi-stable state, the spring plate is in a stable equilibrium, and, therefore, no energy has to be used to maintain the bi-stable bending state. However, in a bi-stable spring plate of this type, there is yet a third, unstable equilibrium state, namely if the spring plate is located exactly in the center position and cannot determine into which of the bi-stable states it will move. Then if interferences are prevented, no energy is necessary to maintain the unstable bending state. Because of this, only a small force is adequate to return the

spring plate to the desired stable bending state. However, for the invention it is not necessary that the two bending states of the spring plate that cause the active and the passive position of the at least one frictional wheel be the bi-stable states of the spring plate. Rather, the spring plate is advantageously in the active position of at least one frictional wheel in one of the stable bending states of the bi-stable spring plate and in the passive position of the at least one frictional wheel in, or near, the unstable bending state of the bi-stable spring plate. In this way, on one hand it is ensured that the at least one frictional wheel is held in the active position by the restoring force of the spring plate in working connection with the transport element. On the other hand, in the passive position of the at least one frictional wheel, no energy or almost no energy is necessary to maintain the passive position, but instead of that a low force is adequate to bring the at least one frictional wheel back to the active position.

In another advantageous embodiment of the device according to the invention, the restoring force stresses the spring plate, which is in the passive bending state, in the direction of the active bending state. In this process the restoring force is applied at least partially by the spring plate and/or advantageously the restoring force is applied at least partially by additional pre-stressing elements. The pre-stressing elements may be leaf springs that at least partially permit a lateral excursion of the spring plate in the bearings. Because of this, the spring plate is better able to move from one bending state to the other.

In another embodiment of the device according to the invention, the actuating element is a cam wheel, whereby the cam wheel has at least one minimum and one maximum radius and the transition between the radii is continuous. In a cam wheel of this type, there is a change from the minimum to the maximum radius every 90° in circumference direction. The different radii cause the actuating path of the cam wheel, the continuous change in the radii permits a protective rolling movement of the cam wheel on the spring plate and thus a continuous bending of the spring plate, which is preferable to an abrupt bending of the spring plate.

In another embodiment of the device according to the invention, the spring plate consists of spring steel; however, a plastic that has comparable elastic properties is also conceivable. It is also conceivable, in a generalization of the device according to the invention, for a

different elastically deformable material to be brought to a deformation state, to a different deformation state and back again by using a suitable actuating element.